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Finding the Effects of Think-Pair-Share on Student Confidence and Participation

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This research study addresses the think-pair-share cooperative learning technique and its effects on students' confidence in their abilities to do mathematics and their willingness to participate in class discussion. The study found that students' participation increased, the number of long explanations given by students increased, and students comfort and confidence when contributing to class discussion also increased.

Introduction

Discussion is an integral aspect of a successful mathematics classroom. Discussion allows teachers to gain insight into their students' understanding. Gaining this insight can be very beneficial to teachers and students because it can allow teachers to tailor their instruction to their students' needs. Discussion as a class or in small groups also allows students to practice critiquing others' reasoning and to practice constructing their own arguments. These are important skills for students to master and will help in their future learning and future lives outside of school. These skills are also required of many students and of all students in Ohio. The Common Core State

Standards of Mathematics require the incorporation of the mathematical process of constructing viable arguments and critiquing others' reasoning (National Governors Association Center for Best Practices & Council of Chief State School Officers, 2010). Also, during discussion, students will be exposed to others' thought processes. This may provide students' appropriate models of mathematical thinking from a peer and may also help students correct their own misconceptions.

It is also important for students to have confidence in their abilities to do mathematics. If students are more confident in their mathematics abilities, they may be more willing to give effort towards learning, believing they will be rewarded for their hard work with increased understanding. Also, they may be more willing to participate in class discussion.

Cooperative learning has been shown to improve students' self-esteem (Goodwin, 1999) which is tied to confidence. Think-pair-share is a cooperative learning technique which involves presenting students with a task or question and giving them time to think by individually. Then in pairs, they report their individual findings, discuss their own thoughts and then refine their individual work if they see fit in order to come up with a consensus on the question or task. Then after pairs have had time to discuss, the class reconvenes and members of the different pairs share their thoughts with the class. Think-pair-share encourages student participation in discussing and promotes forming and critiquing arguments both in small and large groups. In the study described in this paper, I will be incorporating think-pair-share into my teaching in order to discover whether or not the cooperative learning strategy, think-pair-share will increase students' confidence in their abilities to do mathematics and their willingness to participate in mathematical whole class discussions.

Literature Review

Incorporating the think-pair-share strategy into the classroom can have many beneficial effects. Think-pair-share is a cooperative learning technique. Cooperative learning has been extensively studied and has been shown to have many benefits for learners (Lujan & DiCarlo, 2006); (Cortright et al., 2005); (Goodwin, 2005); (Reinhart, 2000). Also, using think-pair-share inherently increases wait time after students are posed with a question or task (McTighe & Lyman, 1988). This allows more time for students to think, and has been shown to get more students involved in discussion and improve the quality of student responses (Rowe, 1972). Think-pair-share is also very useful to teachers because it can be used as a valuable form of formative assessment (Cooper & Robinson, 2000).

In order for meaningful learning to occur, students must interpret, relate, and incorporate new information with students' existing knowledge and experiences (Cortright et al., 2005). Students must actively process information in order to learn (Lujan & DiCarlo, 2006). Direct instruction and other teacher to student interactions do not always allow students these opportunities. Cooperative learning allows students the opportunity to work together to build a meaningful understanding of class material. Cooperative learning involves students working in small groups towards a common goal in order to increase their own and other students' understanding (Johnson & Johnson, 1999). Cooperative learning allows students to process new information and, through discussion and peer to peer interaction, assign meaning to what is being learned (Lujan & DiCarlo, 2006).

There are five key components of cooperative learning defined by David Johnson and Roger Johnson (1999). The first is positive interdependence. This means that students will have two main goals in cooperative learning: to learn and to make sure their other group members learn. When the positive interdependence is established, students understand that their individual success rests on the success of their group members. Also, students will recognize that every student is needed and presents valuable resources and perspectives, so every group member's participation and engagement is essential (Johnson & Johnson, 1999).

The next aspect of cooperative learning is face-to-face promotive interaction. This means students encourage each other, assisting each other, challenge each others' conclusions to promote thought and discussion, give feedback to others, and motivate each other to strive toward achieving mutual goals (Johnson & Johnson, 1999). Another aspect of cooperative learning is individual accountability and personal responsibility. This means that each student is responsible for his or her individual learning and that they are accountable to their group for their efforts towards achieving group goals. Individual accountability and personal responsibility ensures that each student is ultimately responsible for him or herself and prevents students from avoiding work and allowing other group members to take more than their share of the group work (Johnson & Johnson, 1999).

The fourth aspect of cooperative learning is the use of interpersonal and small group skills. This means that students must be able to effectively communicate with each other and constructively resolve conflict (Johnson & Johnson, 1999). The final aspect is group processing in which group members determine what is successful or what should be changed within the group (Johnson & Johnson, 1999). These five aspects have been shown to allow cooperative learning to be more beneficial than other types of learning, namely competitive and individualistic learning (Johnson & Johnson, 1999).

Research has shown that cooperative learning increases students' understanding and ability to integrate and synthesize new material (Lujan & DiCarlo, 2005). Cooperative learning has also been shown to increase academic achievement, positive social skills, and self-esteem (Goodwin, 1999). Also, cooperative learning has been shown to aid critical thinking, problem-solving, and decision-making skills (Cortright et al., 2005). Action research has also concluded that cooperative learning, and specifically the think-pair-share strategy, increased student participation in large group discussions. The think-pair-strategy is one way to incorporate cooperative learning into a classroom in order to give students the opportunity to actively process and develop a meaningful understanding of class material.

One middle school math teacher, Steven C. Reinhart, conducted his own study of his classes over a number of years, trying to improve his teaching by using a problem-based, student-centered approach and incorporating more cooperative learning techniques (2000). He did this because he noticed many of his students did not understand concepts he thought he had taught well with direct instruction. He decided to do what he could to allow students the opportunity to process information and explain their ideas. One technique he often used was think-pair-share. He found that in his classroom, think-pair-share helped to improve class discussions more than any other technique he incorporated into his teaching. He noticed that this technique, by first allowing students time to think individually, increased individual accountability and personal responsibility for learning and participation in class compared to starting out in a group, which is one vital aspect of successful cooperative learning. He also noticed that students were more willing to share ideas with the whole class when the responsibility for the response was shared with the partner. He concluded that by using think-pair-share and other cooperative learning strategies, he gave students the chance to develop deeper understanding of class material, and he was able to better see what his students understood.

Another study conducted by Ronald N. Cortright, Heidi L. Collins, and Stephen E. DiCarlo used a technique similar to think-pair-share which they called peer instruction (2005). They divided an undergraduate exercise physiology class into two heterogeneous groups, group A and group B. Each of the classes consisted of three presentations and after each the students were given a short quiz about the presentation. Students in group A could discuss the questions with a group of 2 to 3 other students and students in group B completed the quiz on their own. Later in the course, the quiz questions involved novel situations. Students had to incorporate the new knowledge from the presentation and their existing knowledge to solve these problems. In addition to the quizzes, students also took a survey about their experiences. The performance on both types of quizzes was significantly greater for those who discussed with peers. Also, students reported that cooperation with peers facilitated their learning. In addition, student reported that they enjoyed peer instruction and peer instruction helped to develop positive relationships between students and faculty and among students. Also, Cortright, Collins, and Dicarlo concluded that the cooperative learning technique of peer instruction led to transfer, allowing students to apply what they have learned to new contexts. Hence this cooperative learning technique led to meaningful learning.

In addition to being supported by research, cooperative learning and the cooperative learning technique, think-pair-share, is also supported by educational theory. Bandura's social cognitive theory is rooted in the idea that there is a triarchic reciprocal causality between behaviors, personal factors, and environmental factors (Bandura, 1989). Behaviors; personal factors like, cognition, goals, and self-efficacy; and environmental factors, like models, instruction, and feedback given to a student all affect one another (Woolfolk, 2011). In other words, if students are paired together, they will be able to discuss each student's thought process. One student may get helpful feedback from his peer or one student may provide an appropriate model for the other student (environmental factors). That student would then have a better understanding of the topic (personal factor). This increase in his understanding may help him want to volunteer a response in class (behavior). He may then gain a mastery experience by receiving recognition of his accomplishment and his helpful addition to class dialogue from his teacher and peers (environmental factor). This mastery experience may help to build the student's sense of self-efficacy so he feels he is more able to successfully contribute to class discussion and succeed in the course. Cooperative learning allows students to receive more feedback from their peers. It allows them to gain mastery experiences and vicarious experiences that help to build self-efficacy, or a student's belief in their ability to bring about a desired effect (Woolfolk, 2011). It may provide students with helpful models which would help their understanding which would in turn help them to have a higher self-efficacy and perhaps set higher goals. These higher goals and the student's self efficacy would in turn help motivate the student to succeed in the future. There are so many positive aspects to the cooperative learning technique think-pair-share that could allow for the positive momentum in this system of triarchic reciprocal determinism.

There are also other beneficial aspects to the think-pair-share strategy in addition to peer cooperation. Think-pair-share also allows students wait time (McTighe & Lyman, 1988). There are two different types of wait time. The wait time 1 is the time spent after a teacher's question and wait time 2 occurs after a student speaks (Rowe, 1972). Think-pair-share allows for the wait time 1 because students are all given that time to think to themselves in silence before they begin to discuss. Think-pair-share can also allow for wait time 2, depending on how students react to each other in discussion and how long the teacher waits before responding to a student's comment (McTighe & Lyman, 1988). Mary Budd Rowe conducted a study of wait time in elementary science programs over five years. The study concluded that allowing three or more seconds for the wait time 1 decreased the number of times students failed to respond or responded that they did not know. Also, prolonging wait time 2 was shown to increase the length of student responses and increase the number of unsolicited but appropriate student responses. Both types of wait time were shown to increase the number of students participating in class discussion, increase the instance of speculative thinking based on evidence, and increase the number of questions asked by students (Rowe, 1972).

In addition to the benefits gained through cooperative learning and increased wait time, the aspect of formative assessment that the think-pair-share strategy provides is valuable to the learning process. Using think-pair-share allows the teacher to gain insight into the quality of student understanding (Cooper & Robinson, 2000). When teachers are able to gauge their students' understanding, they can use this information to alter their instruction in a way that would be more beneficial to learners (Boston, 2002). Informal formative assessment describes the process of teachers gaining new information about student understanding and using that information to immediately shape the instruction in order to better facilitate student learning (Ruiz-Primo, 2011). Informal formative assessment can occur the during student-teacher or student-student interaction (Ruiz-Primo, 2011) that takes place during think-pair-share. These interactions allow teachers the opportunity to observe students' thinking through their explanations and dialog. According to Maria Araceli Ruiz-Primo, effective assessment conversations are guided by learning goals, include a wide range of students, and allow students to comment on each other's responses and argue and support their claims with evidence (2011). Since a think-pair-share session is always initiated to discuss a specific problem or idea, it should always also be guided by the learning goal associated with the particular question or idea. Also, think-pair-share allows the opportunity for teachers to hear a wide range of students by circulating during the pairing stage and in class discussion. In addition, the increased wait time aspect of think-pair-share has been shown to increase the number of students participating in class discussion and would increase discussion based on evidence (Rowe, 1972), so these important aspects of effective informal formative assessment are built into the think-pair-share strategy.

The think-pair-share technique is a combination of many beneficial classroom practices. It inherently allows for an increase in wait time 1. Therefore, by Rowe's findings (1972), it is likely that think-pair-share will increase the number of students participating in whole class discussion and increase discussion based on evidence. Other cooperative learning techniques have been shown to increase students' self-esteem (Goodwin, 1999). In addition, action research has shown that think-pair-share does increase student participation in class discussions (Reinhart, 2000). For these reasons, it is my hypothesis that think-pair-share will increase student participation in class discussion as well as students' confidence in their mathematics abilities. I will test this hypothesis for the students in my student teaching class.

Methodology

In order to study think-pair-share and the effect it has on students, I will give the students a pre-survey to measure how often they believe they participate in class, how they feel about participating in class discussion, and their confidence in their mathematics abilities. I will also give the same survey as a post-survey. This will give me an idea of how students feel about their math abilities and participating in math discussion. This will also help me to get a picture of the students' confidence in their math abilities and willingness to participate both before and after incorporating think-pair-share regularly. This will help me to see if think-pair-share had an effect on their confidence and willingness to participate in discussion.

I will also video record one week of teaching in which I do not use the think-pair-share technique and one week in which I incorporate the technique into instruction. While reviewing the field tapes I will note who participates and how often. I will note when each student poses a question (Q), gives a long explanation (L), gives a quick answer (A), or gives an inflected response (I).

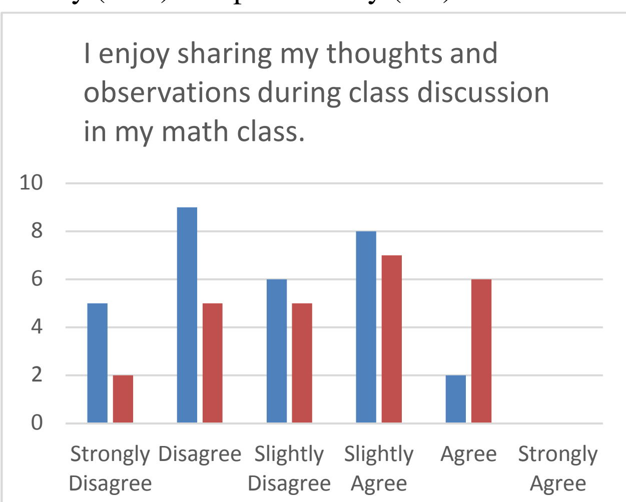
The observations before using think-pair-share will give me a base-line of the student participation in the particular class. This will help me to see who dominates discussion, who avoids participation, and what type of comments and questions are given during class discussion. This will help me to compare class discussion before and after the use of think-pair-share.

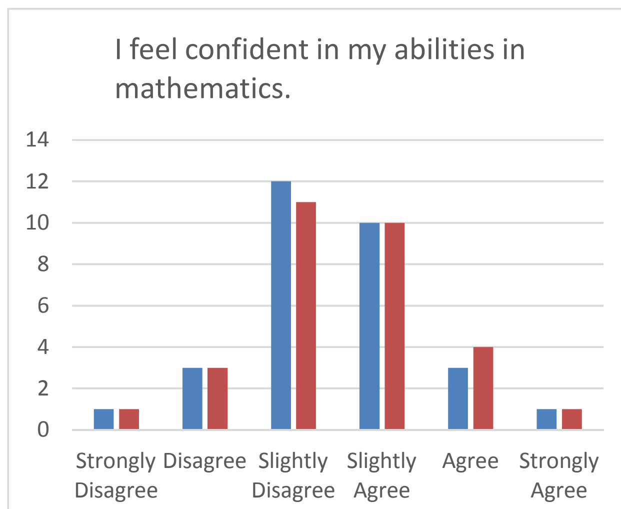
Observing during the use of think-pair-share will give me data to determine if any changes in student participation occur.

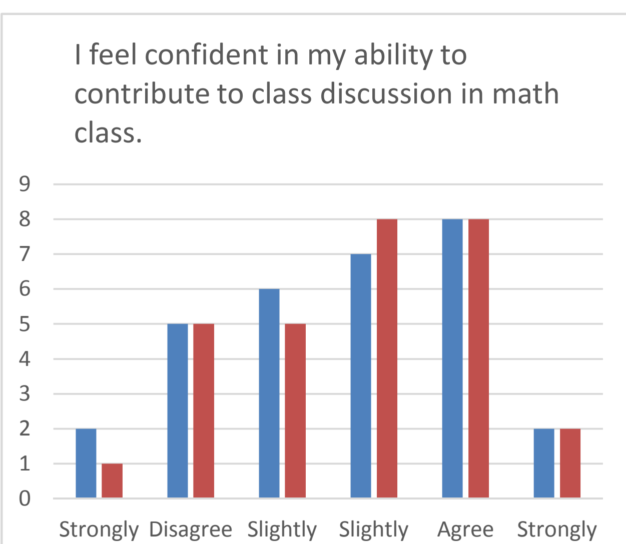
These data sets collected in two different manners together will help me to get a thorough picture of my students' view of their abilities and their confidence in their math abilities. It will also help me to get a picture of their actual participation in class discussion and the ways in which they participate. I will then be able to determine if the use of think-pair-share has an effect on student participation and confidence.

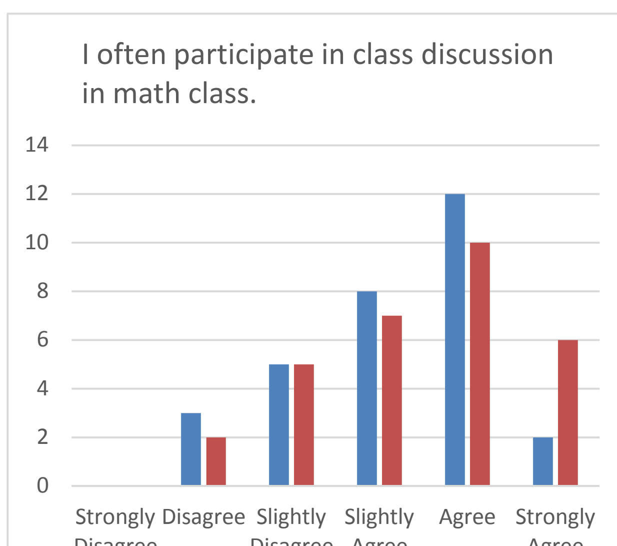
Data and Analysis

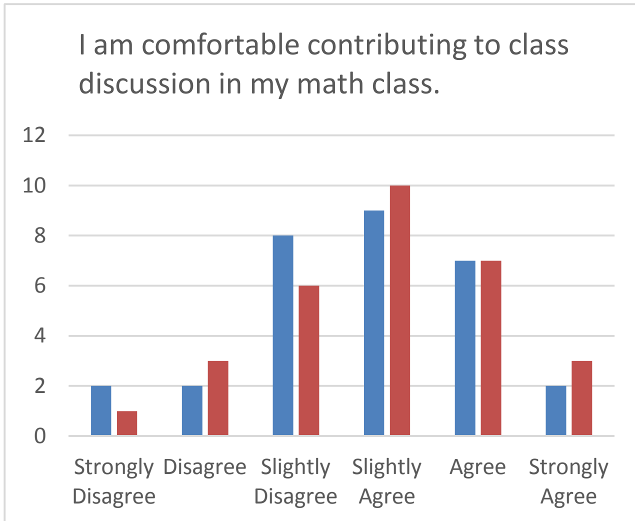
The students took a survey about their class participation and confidence at the beginning and at the end of the study. Below are charts comparing the answers students selected in the pre-survey (blue) and post-survey (red).











The results of the pre-survey and post-survey suggest that think-pair-share had a positive impact on students' views about participating in discussion in math class. Every question showed an improvement in the post-survey compared to the pre-survey. The surveys' results suggest that students believe using the think-pair-share technique contributes to more student participation. Students also indicated that they enjoyed participating more in class discussion when using the think-pair-share technique. Students' comfort when contributing to class discussion was also improved. Students' confidence in their mathematics abilities and their confidence in their ability to contribute to discussion were positively affected, but only a very small number of students noted an improvement in these areas.

In the first week of the study in which think-pair-share was not used, the mean average number of student comments was 23.75 and the average number of long explanations was 3.75. The second week while using think-pair-share the average number of student comments was 28.25 and the average number of long explanations was 7. This data suggests that using think-pair-share facilitates increased student participation in class discussion and increases the quality of student responses. Therefore my hypothesis was supported by the data collected.

Conclusion

From this study, I have gathered that using think-pair-share in my classroom allowed me to increase the amount that students participated in class discussion, increase the number of long explanations students gave, and increase their comfort when sharing their thoughts and ideas.

By increasing student participation in class discussion and by increasing students' long explanations, students are communicating their thinking more to myself and other students. This has many benefits including providing the opportunity for students to learn from each other, practice using and developing their mathematics vocabulary, practice using mathematical reasoning skills, and providing me with a form of formative assessment. Using this technique also seemed to help a few students increase their confidence in their mathematics abilities and ability to contribute in class discussion. These results reinforce my decision to use think-pair-share in my instruction and I will continue to use this cooperative learning technique.

Although I did get very positive results, this may only be due in part to using think-pair-share. Many students expressed to me that the content we covered while we were not using think-pair-share was more challenging for them. While not using think-pair-share, the class was studying how to simplify exponential expressions. The students studied exponential expressions and used repeated multiplication to define rules to follow when simplifying exponential expressions. While using the think-pair-share technique students studied exponential functions and got to do some more interesting applications of exponential growth and exponential decay and geometric sequences. Many students enjoyed the later content more and even commented that they felt it was easier than simplifying exponential expressions. The students' assessments also suggested that the students found simplifying exponential expressions to be more difficult.

This difference in difficulty for students could lead to students feeling more comfortable and confident with the content they enjoy more and that is easier for them to understand. Also, if students understand the content more they may be more willing to contribute to discussion, and they may have a greater ability to give long explanations. Therefore, this difference in content was a limitation of this study.

In the future, I would like to collect data for a longer period of time in order to gain more meaningful and representative results. I would like to study students' participation and confidence during different units so that I can determine whether the content is playing a significant role in the results. However, reviewing hours of video was very time consuming, and I do not think that this would be very practical for a longer study. I would like to develop a color-coded chart so that each comment type has a color and each student would have a box of every color. That way I could very quickly make tally marks during instruction. This would allow me to conduct a longer and more thorough study.

Bibliography

Bandura, A. (1989). Social cognitive theory. *Annals of child development, 6.* 1-60. Greenwich, CT: JAI Press.

In this paper, Bandura further expounds upon his Social Cognitive Theory. The paper deals with many aspects of the theory including triarchic reciprocal causality and self-efficacy.

Boston, C. (2002). Cleaning house on assessment and evaluation. *The concepts of formative assessment. ERIC Digest.*

This source focuses on the benefits of formative instruction and how it can be implemented. Boston explains the importance of teacher observation, use of questioning, and incorporation of classroom discussion as ways to obtain data about student learning.

Cooper, J. L. & Robinson, P. (2002). Getting started: Informal small-group strategies in large classes. *New Directions for Teaching & Learning,* (81), 17.

Cooper and Robinson discuss several ways to incorporate small group strategies into large classes. These include using addressing a launch question in groups, stopping to work with others for comprehension checks, and specifically, using think-pair-share.

Cortright, R. N., Collins, H. L. & DiCarlo, S. E. (2005). Peer instruction enhanced meaningful learning: Ability to solve novel problems. *Advances in Physiology Education, 29*(2), 107-111.

This study examined the effectiveness of peer instruction, one cooperative learning technique. The study was conducted in an undergraduate class. Their research showed a significant improvement in students' mastery of material and ability to solve novel problems following peer instruction.

Goodwin, M. W. (1999). Cooperative learning and social skills: What skills to teach and how to teach them. *Intervention in School & Clinic, 35*(1), 29.

Goodwin links the use of cooperative learning techniques to the teaching of and students' acquisition of social skills. The article includes gives research-supported techniques and summarizes the benefits including improvements in students' self-esteem and academic performance.

Johnson, D. W., & Johnson, R. T. (1999). Making cooperative learning work. *Theory into Practice*, *38*(2), 67-73.

This source gives an overview of cooperative learning. Johnson and Johnson review and summarize research about cooperative learning. It includes an explanation of cooperative learning and how it differs from group work, summarizes the basic elements of cooperative learning, and gives examples of types of cooperative learning techniques and their uses.

Lujan, H., & DiCarlo, S. E. (2005). Too much teaching, not enough learning: what is the solution?. *Advances in Physiology Education*, *30*(1), 17-22.

This article provides a review of literature about how to increase meaningful student learning. It centers around the fact that active processing of information, and not memorization, leads to meaningful learning. Several research backed curricular changes that lead to meaningful learning are included.

McTighe, J., & Lyman JR., F. T. (1988). Cueing thinking in the classroom: The promise of theory-embedded tools. *Educational Leadership, 45*(7), 18.

This source gives an explanation of effective instructional techniques. Think-pair-share is included as one of the featured techniques. Research is sited to support the use of these techniques.

National Governors Association Center for Best Practices & Council of Chief State School Officers (2010). *Common core state standards*. Washington D.C.: National Governors Association Center for Best Practices, Council of Chief State School Officers.

These Standards define the educational objectives for students in forty-eight states. These standards help to standardize education across the country. They focus not only on content but on problem-solving and reasoning skills.

Reinhart, S.C. (2002). Never say anything a kid can say!. *Mathematics teaching in the middle school, 5*(8), 478.

Reinhart explains the trouble he had with direct instruction and how to improve student achievement by getting students to explain their reasoning and become actively involved in class. He gives tips to follow in order to create an environment in which students are willing and feel comfortable to share their thoughts. One of his recommendations is the incorporation of think-pair-share.

Rowe, M. (1972). *Wait-time and rewards as instructional variables: Their influence on language, logic, and fate control.*

This paper summarizes a study of the effects of wait-time conducted over five years. Evidence collected showed that increasing wait-time improved student responses in quality and frequency. It also shows that teachers become more flexible and develop higher expectations for lower achieving students.

Ruiz-Primo, M. (2011). Informal formative assessment: The role of instructional dialogues in assessing students' learning. *Studies in Educational Evaluation, 37*(1), 15-24.

This article reviews and summarizes research about informal formative assessment conducted through observing student dialogue. Ruiz-Primo discusses how instructional dialogues can easily also be assessment conversations. She describes the usefulness of these conversations as well as some strategies to employ.

Woolfolk, A. (2011). *Educational psychology: Active Learning Edition*, 11th ed. Boston: Allyn & Bacon.

This textbook gives an overview of many aspects of educational psychology. This includes child and adolescent psychological development, best teaching practices based on child and adolescent development, psychology of motivation, and other aspects of education psychology.